The Laws of Existence and the Structure of Our Universe

Version 3

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ABSTRACT

This article aims to formalize the concept of existence and establish the geometric constraints and laws governing it. A mathematical framework is developed to align with these laws and accommodate observations from both General Relativity (GTR) and Quantum Mechanics (QM). Within this framework, key quantum processes, such as superposition and quantum tunneling, are shown to be predictable, suggesting that they adhere to classical logic. The framework is then examined in the context of the Michelson-Morley Experiment. Finally, the article proposes a model for quantum gravity based on these findings.

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1. INTRODUCTION

Quantum mechanics (QM) has understandably perplexed physicists since its inception in the early 20th century. Richard Feynman famously captured this sentiment with his remark, "I think I can safely say that nobody understands quantum mechanics." Pioneering physicists like Niels Bohr, Max Planck, and Erwin Schrödinger encountered phenomena such as the photoelectric effect, quantum tunneling, and the Compton effect, which seemed to defy classical logic. Thus, at some point, a fascinating shift occurred: the classical logic that led us to QM no longer seemed sufficient to describe the quantum world resulting in developments like that of quantum logic.

With that said, physics often takes a "top-down" approach, focusing on successful predictions rather than intuitive explanations. This is respectfully likened to solving a system of two linear equations in which, instead of solving them algebraically (analogous to using logic), one guesses values for x and y until they produce acceptable results (sometimes analogous to physics). Without having a logical solution for the system, there will always be some level of error. Logic therefore provides the set of all possible realities, and physics has to work within such a framework for any theory to be feasible. As an example as to why this is important, String Theory proposes that the fundamental building blocks of the universe are 1-dimensional vibrating strings [1]. However, as shown below, a 1-d string cannot possess a property, and thus cannot exist. Therefore, String theory can end up being a great success, but it does not fit within the confines of classical logic and thus it is not realistic.

This research explores the hypothesis that a revised classical framework can account for quantum phenomena, offering a potential alternative to existing interpretations. Since the proposed framework is based on classical logic, and compatible with both the experimental results in QM and GTR, this framework is a generalization in which to build a theory of everything such that there aren't any contradictions or paradoxes.

2. DEFINITIONS

Classical logic is a formal system for reasoning that deals with propositions (true/false statements), logical operators (AND, OR, NOT, etc.), mathematics, and truth tables. It allows for constructing valid deductive arguments where the conclusion necessarily follows from true premises. It does not include multivalued, fuzzy, or quantum logic.

A **property** is an intrinsic, non-trivial attribute of an entity independent of subjective perception or geometrical characteristics (i.e a square has the property of being square but that is a geometrical characteristic and thus does not satisfy the specific definition. Likewise, an imagined entity can have the property of change within the mind, but this is subjective and thus also does not satisfy the intended definition.).

Existence refers to the state or condition of possessing at least one property that distinguishes an entity from non-existence. It implies the actuality or reality of an entity, independent of subjective perception or mental constructs (in this context, epistemological existence is ignored). The word existence, or **existences**, is used to reference an entity that possesses a property and thus also therefore exists.

An **entity** is an object or concept that is independent of subjective perception or mental constructs that either exist or they don't. Entities can possess properties that contribute to their existence and define their identity (i.e an imagined sphere is an entity, but it does not possess a property, thus it cannot exist. An electron can exist because it has a property of charge.).

Property density is the quantified magnitude of a property possessed by an entity divided by the entity's length, area, or volume as specified by the context.

Binding Property is any property that binds an existing entity together. A binding property, like all properties, must have an internal flux.

Flux is the measure of how much of a property of an entity passes through a boundary. It indicates the flow, transfer, or influence of the property across or through the specified area or region, regardless of whether the property physically moves or not.

A **transition** involves altering an entity's property or spatial extent.

A **volumetric** geometry occupies empty space and excludes regions that are strictly a point, area, or length (i.e Two spheres connected by a line is not a volumetric geometry, whereas the two spheres sharing some volume is.).

Space is the expanse that contains the universe's matter and energy, in addition to the matter and energy itself. If dimensionality is defined beyond the universe, space includes that as well. **Empty Space** references the same but without the presence of any existence.

To **constrain** means to impose limits or conditions.

Information is a quantifiable and interpretable representation of the state or properties of a system, whether physical or logical.

Causality is the principle that specifies a cause-effect relationship between events such that the state of a system at one point determines its state at another point, consistent with the governing laws of the system.

3. FOUNDATIONAL PRINCIPLES

3.1 Negating the use of the Dirac Delta Function on point-particles

Loose Definition: Consider the Dirac delta function $\delta(x - \alpha)$, misleadingly characterized such that $\delta(x \neq \alpha) \equiv 0$, $\delta(x = \alpha) = \infty$, and $\int_{\alpha^-}^{\alpha^+} \delta(x - \alpha)dx = 1$ [2]. In mathematics, ∞ represents the concept of being unbounded, and is not a number. Therefore $[\forall\, z \in \mathbb{R},\ z \neq \infty] \rightarrow [\forall\, x,\ \delta(x - \alpha) \neq \infty]$. The spike has an area of $[\Delta x \equiv 0] \cdot [\delta(0) \neq \infty] = 0$ contradicting the third condition. That is:

$$[\int_{\alpha^-}^{\alpha^+} \delta(x - \alpha)dx = 1] \wedge [\delta(x \neq \alpha) \equiv 0] \rightarrow \perp$$

Formal Definition: Now the main purpose of the delta function is to sift out the value of a function at a point, so its formal definition is just that $\delta(x - \alpha)$ satisfies the property $\int_{-\infty}^{\infty} \delta(x - \alpha)f(x)dx = f(\alpha)$ [2]. In this case, the delta function is a distribution that picks out specific value(s) of $f(x)$ such that the property holds. Notice that if the domain of the delta function is not continuous at any point, then at each point the delta function reduces to the first definition. That is, if the domain $D_\delta = \{\alpha_1, \alpha_2, ...\}$, then:

$$\begin{aligned}\int_{-\infty}^{\infty} \delta(x - \alpha)f(x)dx &= \int_{\alpha_1^-}^{\alpha_1^+} \delta(x - \alpha_1)f(x)dx + \int_{\alpha_2^-}^{\alpha_2^+} \delta(x - \alpha_2)f(x)dx ... \\ &= [\delta(0)f(\alpha_1) \neq \infty] \cdot 0 + [\delta(0)f(\alpha_2) \neq \infty] \cdot 0 ... \\ &= 0\end{aligned}$$

It follows that $\exists\, D \subset D_\delta$ | D is continuous. Likewise, if $D_f = \{\alpha_1, \alpha_2, ...\}$, then the same result occurs. Thus $\exists\, D_{\delta f} \subset D_\delta \cap D_f \mid D_{\delta f}$ is continuous.

Now consider a particle that has some field $f(x)$. In order to be measured, that field must first exist. Therefore by using $f(x)$ with the delta function, one would be modeling the existence of the field as if it were a point-particle, and would not be modeling an actual point particle. It follows that for a point particle, $D_f = \{\alpha_1\}$, thus $\int_{-\infty}^{\infty} \delta(x - \alpha)f(x)dx = 0$. This eliminates the entire purpose of the delta function in relation to point-particles.

With that said, it is important to clarify why the delta function is still meaningful in physics. Consider the Gaussian distribution $G(x, \beta) = |\beta|e^{-(x\beta)^2}/\sqrt{\pi}$, where over the real number line $\int_{-\infty}^{\infty} |\beta| e^{-(x\beta)^2} / \sqrt{\pi} dx = 1 \; \forall \; 0 < |\beta| < \infty$ [3]. By l'hopital's Rule, $\forall \; x \neq 0$

$\lim_{\beta \to \infty} |\beta| e^{-(x\beta)^2} = \lim_{\beta \to \infty} 1/(2\beta x^2 e^{(x\beta)^2}) = 0$. Thus $G(x \neq 0, \beta \to \infty) = 0$. At the point q

$x = 0$, $G(0, \beta) = |\beta| e^{-(0\beta)^2} / \sqrt{\pi} = |\beta| / \sqrt{\pi}$, and thus $G(0, \beta \to \infty) = \lim_{\beta \to \infty} |\beta|$. Therefore:

$$G(x \neq 0, \beta \to \infty) = 0$$
$$G(0, \beta \to \infty) \to \infty$$

That is, $G(x, \beta \to \infty)$ models the first two conditions in the first definition of the delta function, but since $\int_{-\infty}^{\infty} G(x, \beta \to \infty) dx = 0$, it cannot simultaneously satisfy the third condition. However, if $|\beta| < \infty$, $\int_{-\infty}^{\infty} G(x, |\beta| < \infty) dx = \int_{-\infty}^{\infty} \delta(x) dx = 1$, thus the delta function produces the correct value for the wrong reason.

3.2 Logic, math, and scientific observations:

The following truths form the foundation of the theory:

Classical logic [4]:

1. Law of Identity ($A \equiv A$)
2. The law of Non-Contradiction ($\neg(p \land \neg p)$).
3. The Transitive law ($(A \to B) \land (B \to C) \to (A \to C)$)
4. The law of Excluded Middle ($(p \lor \neg p)$).
5. The law of Contraposition ($(p \to q) \leftrightarrow (\neg q \to \neg p)$)
6. De Morgan's laws ($\neg(p \land q) \leftrightarrow \neg p \lor \neg q$ and $\neg(p \lor q) \leftrightarrow \neg p \land \neg q$)

Applied Mathematics:

1. Local Homeomorphism Theorem.
2. Whitney Embedding Theorem [5].
3. The principles and methodologies of general mathematics, particularly calculus, differential geometry, and real analysis.
4. The Finite Precision Theorem (Infinite precision is not obtainable on a continuous spectrum).

The following scientifically verified experimental results and observations:

Gravitational lensing, gravitational time dilation, Lorentz time dilation, invariance in the measurement of c, Hubble's Law, gravitational waves, quantization, superposition, entanglement, tunneling, wave-particle duality, uncertainty

4. Formalizing the Concept of Existence: Definitions and Laws

To develop a robust theory of everything, it is imperative to derive a logical framework that defines the boundaries of all possibilities and then refine this framework using scientific observations. As a result, some deductions made herein may initially seem at odds with existing scientific findings. However, when integrated into the broader theoretical context, they align with empirical observations.

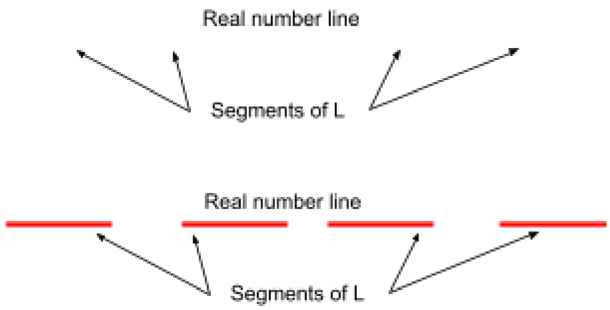


Fig 1 represents the distinction between an entity having a property, and thus existing; and an entity not having a property, and therefore not existing. At the top, an entity does not have a property that allows it to be distinguished from the real number line and thus this represents an entity that does not exist. At the bottom is an entity that is divided into k equal parts, in which each part has the property of being red that allows it to be distinguished from the real number line.

4.1 The general concept of existence

While mathematical objects do not exist (ontologically), the following acts as a concept for deducing what it means to exist. Let L denote the line segment [0,1] on the real-number line ℝ. Dividing L by a positive natural number k yields k individual, equal-length line segments. At the top of **Fig 1**, each line segment has a length of L/k but initially lacks any distinguishing property that sets it apart from the continuum of ℝ itself (thus it is represented as being invisible). Below this representation, the same number line is depicted with segments of L colored red. This red coloring serves as a distinguishing property that defines the existence of these segments relative to the number line. As established by the following theorems, existence necessitates a type of geometry (like the length of the line segment), in conjunction with a property (like those associated with appearing red) that distinguishes it from that which doesn't exist. Just as L can be divided into smaller segments, an existence can also be divided into smaller parts unless there is a specific constraint that prevents such division. The following theorems establish the laws of existence.

4.2 Existence laws

Define the following for an entity Z:
$P(Z)$: The entity Z has a property.
$S(Z)$: Z has the property of self-causation, suggesting Z can cause its own existence.
$C(Z)$: Z has the property of constraining.
$E(Z)$: The existence of Z can arise from non-existence.
$B(Z)$: Z began to exist indicating a transition into existence.
$O(Z)$: Z was formed from at least one already existing entity.
$I(Z)$: Z possesses the property of having information.

4.2.1 Properties

By the definition of existence, if Z exists then it has a property, and if Z has a property, then it exists. Thus:

$$[Def.\ of\ Existence] \rightarrow [P(Z) \leftrightarrow Z]$$

4.2.2 Self-Causation

By the definition of S(Z), $S(Z) \rightarrow P(Z)$; and by the Definition of Existence, $P(Z) \rightarrow Z$. Thus, by the transitive law $S(Z) \rightarrow Z$, and by its contrapositive $\neg Z \rightarrow \neg S(Z)$. Thus, if Z doesn't exist, it cannot cause itself to exist. Thus:

$$\neg S(Z) \quad \text{(Self Causation Negation)}$$

Therefore, Z cannot be self-causing. To clarify, if two pre-existing entities combine to form Z, it is the interaction between these two entities that results in the formation of Z, rather than Z causing its own existence.

4.2.3 Constraint

By the definition of C(Z), $C(Z) \rightarrow P(Z)$. Combined with the Definition of Existence, the antecedent of the transitive law is $[C(Z) \rightarrow P(Z)] \wedge [P(Z) \rightarrow Z]$. Thus:

$$C(Z) \rightarrow Z \quad \text{(Constraint Law)}$$

Thus, for Z to be constrained, Z must first exist. By the contrapositive of the Constraint Law, if Z does not exist, it cannot be constrained to begin existing (from non-existence). It should be clarified that the converse of the Constraint Law is not necessarily true. That is:

$$\Diamond(Z \nrightarrow C(Z)) \quad \text{(Non-Biconditional Constraint Law)}$$

Thus it is possible that two entities exist that cannot constrain each other, and are thus able to occupy the same spatial coordinates. It should be noted that the Non-Biconditional Constraint Law is used as a reference for clarity, not as part of the logical argument, and thus the introduction of the diamond operator should be appropriate.

4.2.4 Continuity

By the Self Causation Negation, Z cannot cause itself to exist; and by the contrapositive of the Constraint Law, Z cannot be constrained to exist (out of non-existence). That is $\neg S(Z) \wedge [\neg Z \rightarrow \neg C(Z)] \rightarrow \neg E(Z)$, thus:

$$\neg E(Z) \quad \text{(Law of Ontological Continuity)}$$

Therefore, Z cannot be produced from non-existence. This implies that if Z began to exist, it must have formed from pre-existing entities. Conversely, if Z was formed from such entities, then Z transitioned into existence. Thus:

$$B(Z) \leftrightarrow O(Z) \quad \text{(Existence Law)}$$

4.2.5 Information

By definition, if Z possesses information, then Z exists. That is:

$$I(Z) \rightarrow Z \quad \text{(Information law)}$$

Thus, information can only be transferred from one existing entity to another through/by an existing entity (Since a field has information, the field exists, hence why the delta function doesn't model a point-particle but instead models a field as a point-particle.).

With this foundation established, it is essential to define existence from a geometric perspective. It is widely accepted, though not assumed within this context, that existence occupies space. However, the question remains: can existence manifest as a point, line, or area? Is existence compressible, or is it divisible? The following discussion seeks to address these inquiries, beginning with the Point Entity Theorem.

4.2.6 Point Entity Theorem

Statement: A point entity can't exist.

Proof: Let Z be a point entity. Define the following:

$V(Z)$: Length, area, or volume of Z.
$\rho(Z)$: Corresponding (to $V(Z)$) average linear, area, or volume property density of Z.
$Point(Z)$: Denotes that Z is a point entity.

1. Z being a point entity implies that $V(Z)$ is identically zero.
$$Point(Z) \rightarrow V(Z) \equiv 0$$
2. The volume of Z being identically zero implies that the product of the volume and the property density is also identically zero.
$$1. \rightarrow \rho(Z)V(Z) \equiv 0$$
3. The product of the volume and the property density being identically zero, implies that Z doesn't have a property.
$$\rho(Z)V(Z) \equiv 0 \rightarrow \neg P(Z)$$
4. Without a property, by the definition of existence, Z cannot exist.
$$\neg P(Z) \land [Def.\ of\ Existence] \rightarrow \neg Z$$

QED

<u>Considerations regarding the Point Entity Theorem:</u> As shown above, the Dirac Delta function cannot recover properties of a point particle. In quantum mechanics, fundamental particles are often considered point-like, and high energy experimentation affirms that no (currently) detectable structure exists [1]. However, the Point Entity Theorem shows that such particles cannot exist. This conflict between classical logic and observation will be addressed later in the article. With that clarified, it is necessary to derive a metric for space that can then be used to define the geometries of entities that exist within it. This leads to the Isomorphism Theorem of Space.

4.2.7 Isomorphism Theorem of Space (ITS)

Statement: In the context where points in space are represented as vectors, empty space is isomorphic to the vector space $(\mathbb{R}^n, \mathbb{R}, +, \cdot)$ for some $n \geq 3$, where $\mathbb{R}^n$ denotes an n-dimensional Euclidean space over the field of real numbers $\mathbb{R}$, and + and · denote vector addition and scalar multiplication, respectively.

Proof: Let S represent points in space, and $\mathbb{R}^n$ be the n-dimensional Euclidean space for some $n \geq 3$. Define $\phi: \mathbb{R}^n \rightarrow S$ by $\phi(< v >) = (v)$, where each vector $< v > \in \mathbb{R}^n$ is mapped to a corresponding point $(v) \in S$.

By the Local Homeomorphism Theorem, for any manifold M of dimension n, any point (v_{origin}) locally resembles $\mathbb{R}^n$. Therefore it is established that for M, representing the geometry of space, $(v_{origin}) = (0, 0, 0...) \in S$, and $< 0, 0, 0... > \in \mathbb{R}^n$, and thus at least one point in S corresponds to a vector in $\mathbb{R}^n$.

By the Law of Excluded Middle, existence either exists at (v), or it doesn't. If existence exists at (v), then (v) must first be well-defined. If existence doesn't exist at (v), then by the contrapositive of the Constraint Law, nothing exists at (v) to prevent existence from existing at (v). Therefore, $\forall < v > \in \mathbb{R}^n$, (v) is well-defined.

Let $< v_1 >, < v_2 > \in \mathbb{R}^n$:

1. **Injective:** Suppose that $\phi(< v_1 >) = \phi(< v_2 >)$. It follows that $(v_1) = (v_2)$, and thus $< v_1 > = < v_2 >$. Therefore ϕ is injective.
2. **Surjective:** For any point $(v_i) \in S \; \exists \; \phi^{-1}(v_i) = < v_i > \in \mathbb{R}^n$. Thus ϕ is also surjective.
3. **Linear:** $\phi(< v_1 + v_2 >) = (v_1 + v_2) = \phi(< v_1 >) + \phi(< v_2 >)$, and $\phi(c < v_1 >) = c(v_1) = c\phi(< v_1 >)$ and thus ϕ preserves vector addition and scalar multiplication.

Since ϕ is bijective and preserves vector operations, it is an isomorphism between $\mathbb{R}^n$ and S.

QED

Considerations regarding the ITS: According to the Isomorphism Theorem of Space, space is smooth, continuous, and infinite in all its defined dimensions, with a Euclidean metric. Every point in space either contains existence or nothing exists there to prevent existence from existing there. Thus, space itself cannot be quantized or discrete. Therefore, for any manifold M representing the real structure of the universe, each point on M can be described as a point in $\mathbb{R}^n$ for some $n \geq 3$. This is very similar to the Whitney Embedding Theorem (WET) stating that a smooth manifold of dimension n/2 can be embedded into $\mathbb{R}^n$ [5], but the WET doesn't guarantee that there will not be deformations whereas the ITS does (for space).

For the structure of the universe (represented by M) to deform in response to mass and energy, by the Constraint Law, it must first exist. In the framework of general relativity, this implies that spacetime itself is a tangible physical entity capable of interacting with matter and energy. Furthermore, since M is not isomorphic to $\mathbb{R}^n$, the universe must exist within infinite nothingness (S). This does not suggest that there is nothing else beyond the universe; rather, it signifies that space is infinite, and everything that exists does so within this boundless expanse.

Now that a metric has been defined for space, it can be used to represent additional geometries of any entity existing within space. This leads to the following theorem.

4.2.8 1-D Entity Theorem

Statement: A 1-dimensional entity cannot exist.

Proof: Let Z be a 1-dimensional entity in space.

1. Let x be a point on Z such that x is not an endpoint:
$$x \in Z \wedge x \notin endpoints(Z)$$
2. By the Isomorphism Theorem of Space, each point x on Z is well-defined:
$$[ITS] \rightarrow \forall x \in Z, \textit{well-defined(x)}$$
3. Since x is not an endpoint, x divides Z:
$$1. \rightarrow x\ divides\ Z$$
4. Since x divides Z, and x is a point, flux does not pass through x.
$$3. \wedge\ Point(x) \rightarrow \neg flux\ through(x)$$
5. Without flux, there isn't a binding property holding Z together at x.
$$4. \rightarrow \neg(binding\ property(x))$$
6. Since x is arbitrary, this applies to all internal points on Z:
$$5. \wedge\ x\ is\ arbitrary \rightarrow \forall x \in Z,\ \neg(binding\ property(x))$$

Since each point x on Z divides Z, and x is a point entity, flux cannot pass through x to bind Z together. Therefore, Z lacks any property that could bind its segments together. Consequently, Z cannot exist.

As a clarification, suppose that the flux of Z goes around the point x, to bind Z together. In this case, such flux is either 1 dimensional and thus bound by this theorem, or such flux is higher dimensional in which the following theorems apply.
QED

Considerations regarding the 1-D Entity Theorem: In string theory, a string is theorized as a one-dimensional entity propagating in spacetime. These strings are hypothesized to be the fundamental constituents of the universe, replacing point-like particles of the Standard Model [1]. However, even if you consider a string as collectively being fundamental, by the 1-D Entity Theorem, there isn't a means for such entities to possess a property, and thus they do not exist.

This is independent of the number of dimensions, presumably 10 or 11, in which the string would propagate. This leads to the following Theorem:

4.2.9 2-D Entity Theorem

Statement: A 2-dimensional entity cannot exist.

Proof: Let Z be a 2-dimensional entity in space.

1. Let x be a 1-d entity on Z such that x divides Z into two sections:
$$x\ divides\ Z$$
2. By the Isomorphism Theorem of Space, each point y on Z is well-defined:
$$[ITS] \rightarrow \forall y \in Z,\ \textit{well-defined(y)}$$
3. Since x divides Z, and x is 1-d, flux does not pass through x.
$$1. \wedge\ [x\ is\ 1d] \rightarrow \neg flux\ through(x)$$
4. Without flux, there isn't a binding property holding Z together at x.
$$3. \rightarrow \neg(binding\ property(x))$$
5. Since x is arbitrary, this applies to all 1-d entities on Z:
$$4. \wedge\ x\ is\ arbitrary \rightarrow \forall x \in Z,\ \neg(binding\ property(x))$$

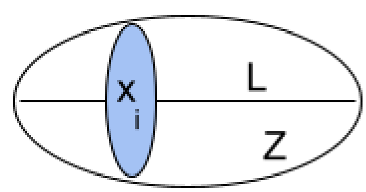
Without a binding property, Z cannot exist.
QED

<u>Considerations regarding the 2-D Entity Theorem:</u> In the context of M-Theory, a 0-brane, 1-brane, and 2-brane cannot exist. This leads us to the 3-D Entity Theorem.

4.2.10 3-D Entity Theorem

Statement: A 3-D entity can exist.

Fig 2 represents a 3-d entity Z, with the longest possible line segment L positioned inside such that both ends of L are on L. The cross-section x_i is perpendicular to L, and divides Z.



Proof: To establish the existence of a 3-d entity, it is necessary to first demonstrate that the same logic preventing the existence of lower-dimensional entities does not prevent the existence of a 3-d entity. Define the following in relation to the **Fig 2**:

Z: A 3-d entity.
L: The longest possible line segment through Z.
|L|: The length of L.
x_i: A cross-section of Z perpendicular to L.

1. By the 2-D Entity Theorem, x_i does not exist (DNE).

$$[2\text{-}D\ Entity\ Theorem] \rightarrow \forall x_i \in Z,\ DNE(x_i)$$

2. By the Constraint Law, x_i cannot prevent flux from passing through it.

$$[Constraint\ Law] \wedge DNE(x_i) \rightarrow \neg Prevent\ Flux(x_i)$$

3. x_i has an area, x_i cannot prevent flux from passing through it, thus a binding property can passes through x_i.

$$Area(x_i) \wedge 2. \rightarrow Z\ can\ have\ binding\ property(x_i)$$

4. Since x_i is arbitrary, this applies for all $x_i \in Z$.

$$3. \wedge x_i\ is\ arbitrary \rightarrow \forall x_i \in Z, Z\ can\ have\ binding\ property(x_i)$$

Therefore, the same logic that prevents a 1-d, or 2-d entity from existing, doesn't apply to a 3-d entity.

It is necessary to establish that, although a 3-dimensional entity can be considered a set of point, line, or area entities that do not individually exist, this does not prevent the existence of the 3-dimensional entity itself. That is. $\forall x_i \in Z,\ x_i$ does not exist, yet Z can exist. To prove this, consider y: $[0, \infty] \rightarrow [0, |L|]$, defined as $y(x_i) = |L|/(1 + x_i)$. For each x_i, the thickness is zero, but the total length of Z is $|L| > 0$. Therefore, by tying the property of Z to the thickness of x_i, such that $\rho_i = \beta x_i$ for some $\beta \neq 0$, a property of Z can be recovered when its length |L| is recovered. That is $\int_0^{|L|} \rho(Z) x_i d|L| = \int_0^{|L|} \beta x_i^2 d|L| \neq 0$. Therefore, a 3-D entity can exist, even though the individual points, lengths and areas comprising it do not exist.
QED

4.2.11 Missing Geometry Theorem

By the Point, 1-D, and 2-D entity theorems, if an entity has a geometry in which any portion is not volumetric, that portion does not exist. Consequently, enclosing an existing entity within a larger entity does not confer existence to the larger entity. Therefore, if two entities are not connected volumetrically, or such volume doesn't have a property, the two entities exist independently.

4.2.12 Mathematical Definition of Existence

The aforementioned theorems establish the criteria for an entity Z to exist. Such criteria can be explicitly defined using the following sets:

$$G = \{g | g\ is\ volumetric\}$$
$$P = \{p | p\ is\ a\ property\}$$

In which the existence of Z is established as:

$$Z = (g, p) \quad \text{(Mathematical definition of existence)}$$

Therefore, the set ξ comprising the entirety of everything that exists is defined as:

$$\xi = \{Z\} \quad \text{(Set of everything that exists)}$$

This formulation encapsulates the idea that an existing entity Z is characterized by a volumetric geometry g, and at least one property p. By the law of Excluded Middle, anything that doesn't satisfy the definition of existence does not exist. Therefore, the set N of everything that does not exist is defined below. It should be clarified that neither N nor ξ exist, and thus to avoid Russell's Paradox, they are excluded from N. That is:

$$N = \{Y \mid g \notin G \ \vee \ p \notin P\} \setminus N, \xi \quad \text{(Set of everything that doesn't exist)}$$

It follows that an entity that has spatial extent but lacks a property belongs to N. Therefore space, despite its spatial nature, does not exist. That is:

$$Space \in N$$

This makes sense intuitively because an existence can move without constraint within empty space. By definition, everything that exists, exists in infinite space. That is:

$$\forall Z \in \xi,\ Z\ exists\ in\ infinite\ space \quad \text{(Law of Spatial Existence)}$$

Now that the geometry g for existence is established, this leads to the following theorem regarding the potential for infinite divisibility.

4.2.13 Existence Divisibility Theorem

Statement: Any existing entity can be infinitely divided into multiple existing entities, provided that a property doesn't prevent such division.

Proof: Let Z be an existing entity. By to the Finite Precision Theorem, any process external to Z cannot divide or compress Z with perfect precision so as to produce $Z_i \subset Z \mid Z_i$ has the geometry of a point, line, or area. Thus, $\forall\, Z_i \subset Z$, the volume $V(Z_i) > 0$. Therefore, let L_i be the longest possible line segment such that both endpoints are positioned on Z_i. Since Z_i has a non-zero volume, the length of L_i, denoted $|L_i|$, is greater than zero ($|L_i| > 0$). Now suppose that Z_i is divided into k equal-length segments sliced perpendicular to L_i such that $|L_i| = k(\frac{|L_i|}{k})$ for some $k \in \mathbb{N}$. If for some k, $\frac{|L_i|}{k} = 0$, then $|L_i| = 0k$ contradicting the premise that $|L_i| > 0$. It follows by contradiction that, $\frac{|L_i|}{k} > 0\ \forall\, k$, and thus Z is infinitely divisible unless a property prevents it.

Consider the case in which Z divides itself. In this scenario, each point, line, or area would repel every other point, line, or area on Z, potentially reducing Z to a set of points, lines, or areas. By the previous theorems, such points, lines, or areas do not exist independently, and thus this scenario is not possible.

Therefore, whether an external process removes a section of Z, divides Z into infinitely many sub-entities, or Z divides itself internally, a subset of Z will never be reduced to zero volume. Thus, Z can be infinitely divided into multiple entities, provided that a property does not prevent it.
QED

4.2.14 Total existence in space is constant

It follows from the Existence Divisibility Theorem that if Z exists, a subset of Z cannot be reduced to non-existence; and according to the Law of Ontological Continuity, Z cannot be produced from non-existence. Therefore, although Z may be added to another existing entity, divided into multiple entities, or permuted, the total existence in space remains constant. Thus:

$$The\ total\ existence\ |\xi|\ in\ space\ is\ constant\ and\ has\ [always]\ existed$$

4.2.15 Existences occupying the same space

With that said, can two existences occupy the same spatial coordinates? By the Non-Biconditional Constraint Law, existence doesn't imply constrainability. Therefore, if two existences do not have properties that interact, then nothing prevents them from occupying the same spatial coordinates. Additionally, even if the properties interact, it is not necessarily true that they cannot occupy the same space. One very particular example should be considered for clarity: Let Z_1 and Z_2 exist, and let ρ_1 and ρ_2 be the respective property densities throughout such that $\rho_1 =- \rho_2$. Therefore, if for some volume element V, Z_1 occupies the same spatial coordinates as Z_2, then the property value within V is $V(\rho_1 + \rho_2) = V(\rho_1 - \rho_1) = 0$ which initially might seem to contradict the claim that the total existence $|\xi| = const$. However, just like two opposing forces canceling doesn't imply that such forces are not being applied, two entities with opposing properties that cancel doesn't imply that the entities cease to exist.

4.2.16 The propagation of information

How is information propagated? Consider two existences, Z_1 and Z_2, in an otherwise empty space, separated by a distance $\varepsilon > 0$. By the contrapositive of the Information Law ($\neg Z \rightarrow \neg I(Z)$), regardless of how small ε is made, neither entity can have any information about the other unless an existence is transferred (or shared) between them. Thus, suppose that existence γ is transferred from Z_1 to Z_2. Consequently, Z_2 can have information about Z_1, but Z_1 cannot have information about Z_2. This sheds light on the potential for fields in Quantum Field Theory.

4.2.17 Spacetime

As stated above, in order for spacetime to be constrained in the presence of mass and energy, spacetime must first exist. Thus, according to the Mathematical Definition of Existence, spacetime must therefore have a volumetric geometry g, and at least one property p: spacetime has a hyper volumetric geometry, and its property is necessarily that of time thus satisfying such definitions. With this clarification, a significant issue with spacetime becomes apparent. By the Information Law, the information of time can only be propagated by an existence. That is: without an existence present to measure, a measurement of time is not possible; and without an existence present, nothing exists that can move through the dimension of time. In the absence of an existence that is moving through time, time is therefore undefined and thus spacetime cannot exist there. This affirms that spacetime must be a continuum in which each point has an existence that is moving through time. However, the issue arises from the fact that if every point in spacetime contains an existence that is inherently moving through time, even a spacetime that is infinite in time would leave no additional room for existences to move without violating the laws of existence. Thus the concept of spacetime is a dead end. Spacetime, along with point particles, strings, and membranes, are examples where physicists use what works rather than what is possible.

With that said, the only way to resolve this contradiction of time, is by strict obedience to the Information Law. That is, time is not a dimension (other than on paper), it is a property of existence. Each existence within the universe has the property of time individually. Such existences can move throughout space and there isn't any governing dimension of time. Within the following framework, it is established that all of the results of GTR occur within a subset of space that is isomorphic to $\mathbb{R}^3$. That is, black holes, time dilation, gravitational waves, etc. all occur within our Euclidean 3-space, in such a way as to be logically sound, and compatible with observations pertaining to QM.

4.2.18 States of existence

It is necessary to define the state of an existence Z. For simplicity, assume that the total existence of Z is fixed. Further suppose that Z takes the form of a rod with non-zero volume. According to the Existence Divisibility Theorem, each point on Z can be sheared, allowing Z to deform and "vibrate" like elements of String Theory. Now, suppose Z exists in the S_z^i state (or configuration). Since Z is assumed to be vibrating, there is some other state S_z^{i-1} in which Z has existed. If Z were to become non-existent temporarily between the states of S_z^{i-1} and S_z^i, then by the Law of Ontological Continuity, Z could not begin existing again to then exist in the S_z^i state, contradicting the premise. Therefore, the state function S_z of Z is continuous, and can thus be expressed as $S_z = S_z(\chi)$ for some parameter χ. Since Z is presumably not produced from another existence, by the contrapositive of the Existence Law, Z did not have a beginning. Thus, the domain of $S_z(\chi)$ can be represented as the entirety of the real number line.

Since causality presumably always holds, $S_z(\chi)$ is necessarily a causal loop in which each state of Z causes the next. It follows that if two existences Z_1 and Z_2 interact, their interaction $\tilde{I}(Z_1, Z_2)$ results in a state that is determined by the applicable laws and the respective states during interaction so as to not violate causality.

4.2.19 Physical Laws and Free-Will

Additionally, since a law (such as a physical law) is information, only an existence can have the property of a law. That is, a law is intrinsic to an existence. Therefore, Suppose that Z has a law that determines each preceding state $S_z(\chi)$ such that causality is never violated.

However, if Z is required to change states due to the property of time, and Z does not have an additional law that determines the following state, then at each state change Z would have a degree of choice introducing the notion of free-will. That is:

$$[Z\ is\ required\ to\ change\ due\ to\ property\ of\ time]\ \wedge\ [Z\ doesn't\ have\ a\ law] \rightarrow [Free\ will]$$

5. FRAMEWORK: THE STRUCTURE OF THE UNIVERSE AND SPACE

It is necessary to establish a framework for physics that is consistent with the aforementioned statements.

5.1 Basic structure of the theory

Define the following:

U(M): This is the universe's structure represented by the manifold M. Within the context of GTR, M serves as the spacetime manifold that models the universe, but M is not the universe itself. For the sake of completeness, if U(M) is composed of distinct existences that perhaps interact like a lattice, then by the Missing Geometry Theorem, U(M) references those distinct existences.

Deform(U): U(M) is constrained to deform by the presence of mass and energy.

Exists(U): U(M) exists.

U_AE: U(M) has either always existed, or it is composed of entities that have.

U_DirUnmeas: U(M) is an existence, or is composed of existences, that have a property that is not directly measurable by current standards.

1. By the Constraint Law, an entity must first exist before it can be constrained. U(M) is constrained to deform under the presence of mass and energy to produce the effects of gravitational lensing, gravitational time dilation etc. Thus:

$$[Constraint\ Law]\ \wedge\ Deform(U) \rightarrow Exists(U)$$

2. $U(M)$ exists, yet we can only measure it indirectly through gravitational waves, gravitational lensing, and even quantum processes, etc.

$$1. \wedge\ [Can't\ directly\ measure\ U(M)] \rightarrow U\_DirUnmeas$$

3. The existence of U(M) implies that it is an element in the set of everything that exists. Thus:

$$1. \rightarrow U(M) \in \xi$$

4. By the Law of Spatial Existence, and the Isomorphism Theorem of Space:

U(M) exists in Space and Space is isomorphic to $\mathbb{R}^n$ for some $n \geq 3$

5. By the Law of Ontological Continuity, U(M) has either always existed, or it is composed of entities that have. Thus:

$$1. \wedge\ [Law\ of\ Ontological\ Continuity] \rightarrow U\_AE$$

Thus, it is established that U(M) is an entity, or a set of entities, that exists in infinite space. Furthermore, these entities are not directly measurable. Notice that thus far, the only physics necessary to establish the theorems and logic of this framework is that which is necessary for determining that $Exists(U)$: namely gravitational waves, or gravitational lensing. By additionally incorporating experimental results from QM, further improvements to the theory can be made as follows.

5.2 Ties to quantum mechanics

In the vacuum of space, before the emergence of any virtual particles, the only existence is the existence of a subset of U(M) that we cannot directly measure. By the Existence Law, it follows that any virtual particles that emerge in the vacuum of space must therefore be formed/created out of U(M) itself. That is, virtual particles must be produced from the only existence that exists in the vacuum of space: namely U(M). The only way this is possible is if the components of U(M) that form a particle, have individual properties that are not directly measurable, but when combined their properties superimpose so as to produce a measurable property. Thus:

VPE: Virtual particles emerge in the vacuum of space.

OEIV: The only existence in the vacuum of space, prior to the emergence of the virtual particles, is that which composes U(M).

QP: The quantum process of virtual particle pair production and annihilation models an exchange in which existences composing U(M), superimpose to produce measurable particles and vice versa.

$$OEIV\ \wedge\ VPE\ \wedge\ [Existence\ Law] \rightarrow QP$$

U_MP: U(M) is composed of multiple existences (think of a uniform lattice), with a variety of unmeasurable properties. When combinations of such existences interact, their properties superimpose, sometimes producing a net property that we can measure, thus forming what we call a particle.

$$QP \rightarrow U\_MP$$

FP_NF: The particles of the standard model are not fundamental.

$$U\_MP \wedge QP \rightarrow FP\_NF$$

QuantAndMult_Lattice: The multiple existences from U_MP are discrete and quantized forming a uniform lattice-like structure. Thus U(M) is lattice-like.

$$U\_MP \wedge [QM\ is\ quantized] \rightarrow QuantAndMult\_Lattice$$

ApproxZeroVol: The volume of the individual existences in QuantAndMult_Lattice cannot be zero, but they can be smaller than detectable range.

$$\diamond(Point\ Entity\ Theorem \wedge [Existence\ Divisibility\ Theorem] \rightarrow ApproxZeroVol)$$

Since particles are formed from combinations of existences that do not individually have measurable properties, it follows that the existences composing U(M) need not individually be bound by our physical laws. Thus there isn't a reason to assume that they are bound by the speed of light, resulting in a logical explanation as to how entanglement can occur. Thus:

UisNotBound: The individual existences u_i composing U(M) are not necessarily bound by our physical laws until they superimpose producing a particle that can be measured. Thus such existences should not be assumed to be bound by the speed of light, or constrained by any other known law other than those of logic.

$$Existences\ in\ U\_MP\ are\ not\ measurable \rightarrow UisNotBound$$

Entanglement: There is an existence that is not directly measurable, that propagates the information between some particles at a speed that is not bound by c.

$$[Information\ Law] \wedge [UisNotBound] \wedge [Entanglement\ occurs] \rightarrow Entanglement$$

Tunneling: There is a non-zero probability that a particle dissociates into its respective existences (each a respective u_i), and can thus bypass a potential well, recombining on the exterior potentially faster than c.

$$UisNotBound \wedge [Tunneling\ Occurs] \rightarrow Tunneling$$

By the Existence Law, the total existence of a particle cannot be produced from non existence, and thus a particle cannot exist in multiple states at once. According to this model, two forms of superposition are allowed:

ExistencesInteract: The individual existences u_i composing a particle can dissociate and their individual states $S(\chi)$ superimpose.

WavesPropU: The particle produces a series of waves that propagate through U(M) and those waves give the illusion of the particle being in a superposition of states.

WaveParticleDuality: The existences making up a particle can collectively act as both a wave and a particle.

$$([Existence\ Law] \wedge [Superposition]) \rightarrow (ExistencesInteract \vee WavesPropU)$$

However, if WavesPropU is true, then there isn't any means for there to be a distinction between when a particle is observed and when it is not. However, if ExistencesInteract is true, then the particle can dissociate when not observed, and remain as a particle when observed. Thus:

$$ExistencesInteract \rightarrow WaveParticleDuality$$

It is thus established that this framework is compatible with observations in QM: namely quantum tunneling, superposition, entanglement, and wave-particle duality. With that said, in reality, everything follows classical logic, but with a lack of knowledge about the state function $S_z(\chi)$, uncertainty emerges.

5.3 Main framework of the theory

With that said, QuantAndMult_Lattice states that the universe has a lattice of quantized existences, and U_MP states that such existences have properties that are not directly measurable, but when superimposed the net property sometimes results in a measurable particle. Thus, define a Compressible Ether (CE) as the lattice that exists throughout the universe, that is composed of the particles described in QuantAndMult_Lattice and U_MP. Furthermore, confine the CE to a subset of space that is isomorphic to a subset of $\mathbb{R}^3$. That is, the entirety of the universe exists within a subset of Euclidean 3-space. Everything that exists within the universe exists within the CE.

It is thus necessary to establish that the CE is able to produce the observations attributed to GTR such as black holes, time dilation, and gravitational lensing. Therefore, define an existence density **ϱ**, of the existences making up the CE per unit volume. It is also necessary to define a weak interaction $\tilde{I}(\gamma,\ CE)$ between the CE, and a photon that is traversing through it. Said interaction must be weak so that over small distances the total interaction is not detectable thus resulting in the speed of light being the same in all directions (within detectible means), yet over vast distances these interactions result in gravitational lensing/redshifting.

With that said, as speed increases through the CE, the number of interactions $\tilde{I}(\gamma,\ CE)$ also increases. Thus, increasing speed through the CE, is similar to being stationary in a region of the CE that has a higher $\boldsymbol{\varrho}$. Therefore, in order for Lorentz time dilation to be compatible with that of gravitational time dilation:

The presence of mass and energy increases $\boldsymbol{\varrho}$, *and velocity increases* $\tilde{I}(\gamma,\ CE)$

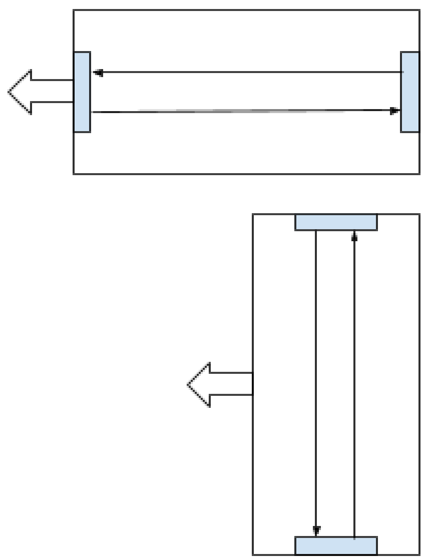


Fig 3 represents a modification to the Michelson-Morley experiment in which two distinct light clocks are positioned perpendicular to each other, and moved through space in the direction of the arrows.

In **Fig 3**, two light clocks are oriented perpendicular to each other similar to the apparatus used in the Michelson-Morley Experiment. Due to $\tilde{I}(\gamma,\ CE)$ being weak, the photons move at the speed of light c in both directions as if the CE were not present. Now suppose that each light clock is increased in length to vast distances, say that between the earth and the sun. The weak interactions $\tilde{I}(\gamma,\ CE)$ would then add up to be sufficient to show that the speed of light is not perfectly invariant. It follows that the concept of time, as measured by the light clocks, becomes more and more distorted the larger the apparatus becomes due to a difference in reading between the vertical and the horizontal clock. Notice that this isn't a paradox or a contradiction since time doesn't exist. This is just a measurement problem.

With that said, it is necessary to establish a light clock K positioned at a point in the CE that has the smallest existence density $\boldsymbol{\varrho}$, and interactions $\tilde{I}(\gamma,\ CE)$. It follows that K measures time to be equal to or faster than any other point within the CE, therefore acting as an upper limit for the rate at which time can be measured. It should be noted that when the time in another location of the CE is compared to K, it is not implied that a measurement is possible, but rather it is being established that in reality there is a relationship with or without a measurement being feasible.

When a photon is produced near K from the components of the CE in accordance with U_MP, the net property necessarily includes the photon moving in the direction of emission. That is, the state function $S_{\gamma}(\chi)$ of the photon results in its motion. Time is then measured, based on the distance the light travels inside of the light clock. As the number of interactions $\tilde{I}(\gamma,\ CE)$ increases, the slower the local speed of light relative to K, and thus the time dilation occurs. However, since time is based on the distance that light travels, all reference frames measure the speed of light to be the same. That is, using a light clock to measure the speed of light implies that such measurement is simply a geometry problem and thus the same results are obtained in all reference frames. Therefore:

The speed of light is not constant universally (relative to k)
but in each reference frame it is measured to be c.

Time is a function of the distance light travels

Since **ϱ** increases in the presence of mass and energy, the number of interactions $\tilde{I}(\gamma,\ CE)$ increases near massive objects resulting in a slower speed of light relative to K. However, as stated above, such a reference frame still measures the same value for c. Likewise, when speed through the CE increases, the same result occurs. Thus this model is compatible with both gravitational and Lorentz time dilation, and the invariance in the measurement of the speed of light.

Since the speed of light decreases near a massive object two things are implied: there can exist a point in which the speed of light becomes zero accounting for the concept of black holes; and the CE has a varying index of refraction accounting for the concept of gravitational lensing.

By UisNotBound, the CE is not bound by our physical laws, and thus it is not limited by the speed of light. Thus the CE can drive the expansion of the universe faster than c in accordance with Hubble's Law.

Since the CE exists, it is conceivable that waves can propagate through it and in doing so, they alter the interactions $\tilde{I}(\gamma,\ CE)$ locally producing a detectable shift in the interferometer at LIGO [6].

5.4 Ties to general relativity

With that said, the results of GTR can be mapped to the structure discussed herein by recognizing that the speed of light dilates in reality, as time dilates in GTR. Thus, let c_0 be the speed of light relative to K. It follows that $c_0 dt = c\, dt_0$, and since $cdt_0 = \sqrt{g_{\mu\nu} dx^{\mu} dx^{\nu}}$ in GTR, it follows that:

$$c_0 dt = \sqrt{g_{\mu\nu} dx^{\mu} dx^{\nu}}$$

Therefore:

$$c_0 = \sqrt{g_{\mu\nu} \frac{dx^{\mu}}{dt} \frac{dx^{\nu}}{dt}} \quad (1)$$

Where t is relative to clock k. Using the equation $c = nc_0$ it follows from equation 1 that the index of refraction (n) of the CE is :

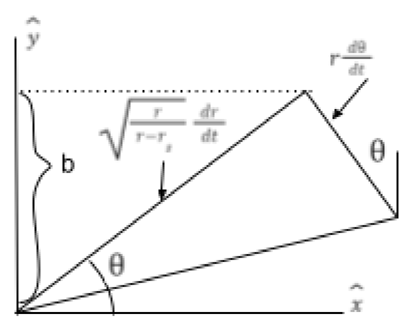
$$n = c/\sqrt{g_{\mu\nu} \frac{dx^{\mu}}{dt} \frac{dx^{\nu}}{dt}} \quad (2)$$

It follows that near an event horizon, the speed of light becomes zero, and therefore time stops relative to K. Gravitational lensing occurs due to the varying index of refraction of U(M). Gravitational waves propagate through the real object U(M).

6. THE QUANTUM NATURE OF GRAVITY

6.1 Derivation of gravitational redshift equation from Schwartzchild metric

Fig 4 shows how the components of the Schwarzschild Metric fit geometrically for a photon initially traveling tangentially to the related mass.



For a photon traveling in a plane in which φ = 0, the Schwartzchild metric [7] yields the following equation:

$$\frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}\left(\frac{dr}{dt}\right)^2 - r^2\left(\frac{d\theta}{dt}\right)^2 = 0 \quad (3)$$

Where $r_s = \frac{2GM}{c^2}$ is the Schwartzchild radius. Adding up the components from **Fig 4** in the $\hat{x}$ and $\hat{y}$ directions yields:

$$< \frac{\partial x}{\partial t} = \sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}cos(\theta) - r\frac{d\theta}{dt}sin(\theta), \frac{\partial y}{\partial t} = \sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}sin(\theta) + r\frac{d\theta}{dt}cos(\theta) > \quad (4)$$

Dividing the x-component of equation 4 by ∂x, squaring both sides, and multiplying by $\partial^2 E$ yields:

$$[\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}cos(\theta) \;-\; r\frac{d\theta}{dt}sin(\theta)]^2 \frac{\partial^2 E}{\partial x^2} = \frac{\partial^2 E}{\partial t^2} \quad (5)$$

Since the $\hat{x}$ direction corresponds to $\theta = 0$, equation 5 reduces to:

$$[\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}]^2 \frac{\partial^2 E}{\partial r^2} = \frac{\partial^2 E}{\partial t^2} \quad (6)$$

Notice the similarity between equation 6 and the wave equation $c^2\frac{\partial^2 E}{\partial x^2} = \frac{\partial^2 E}{\partial t^2}$. From equation 3, $\frac{r}{r-r_s}(\frac{dr}{dt})^2 = \frac{r-r_s}{r}c^2$, and thus equation 6 can be written as:

$$\frac{r-r_s}{r}c^2 \frac{\partial^2 E}{\partial r^2} = \frac{\partial^2 E}{\partial t^2} \quad (7)$$

Setting E = R(r)$\mathbf{T}(t)$ in equation 7, and solving for R(r) yields:

$$\frac{d^2R(r)}{dr^2} =- [k^2\frac{r}{r-r_s}]R(r) \quad (8)$$

Therefore the wavelength of the photon in equation 8 is related by the equation:

$$k\sqrt{\frac{r}{r-r_s}} = \frac{2\pi}{\lambda}$$

Thus, the wavelength λ as observed at radius r is related to the wavelength λ_∞ at infinity by [8]:

$$\lambda = \frac{2\pi}{k}\sqrt{\frac{r-r_s}{r}} = \lambda_\infty\sqrt{\frac{r-r_s}{r}} \quad (9)$$

6.2 The force of gravity written in terms of quantum processes

In a relatively stationary reference frame: The momentum p of a photon is $\frac{h}{\lambda}$ [9]. Using equation 9, for k number of photons, this can be written as:

$$M(p) = \frac{hk}{\lambda_\infty\sqrt{\frac{r-r_s}{r}}}$$

$$= \frac{hk}{\lambda_\infty}\sqrt{\frac{r}{r-r_s}}$$

Therefore the measured force exerted by the photon as it is omitted from an object O is:

$$M(F) = \frac{hk}{\lambda_\infty}\frac{d}{dt}(\sqrt{\frac{r}{r-r_s}})$$

$$= \frac{hk}{2\lambda_\infty}(\frac{dr}{dt} = c)(\frac{1}{\sqrt{r(r-r_s)}} - \frac{\sqrt{r}}{(r-r_s)^{1.5}})$$

$$= \frac{hkc}{2\lambda_\infty}\left(\frac{r-r_s}{\sqrt{r}(r-r_s)^{1.5}} - \frac{r}{\sqrt{r}(r-r_s)^{1.5}}\right)$$

$$= \frac{hkc}{2\lambda_\infty}\left(\frac{-r_s}{\sqrt{r}(r-r_s)^{1.5}}\right)$$

Therefore:

$$M(F) = \frac{-GMhk}{c\lambda_\infty}\left(\frac{1}{\sqrt{r}(r-\frac{2GM}{c^2})^{1.5}}\right) \quad (10)$$

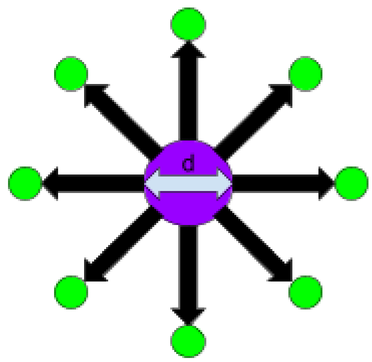
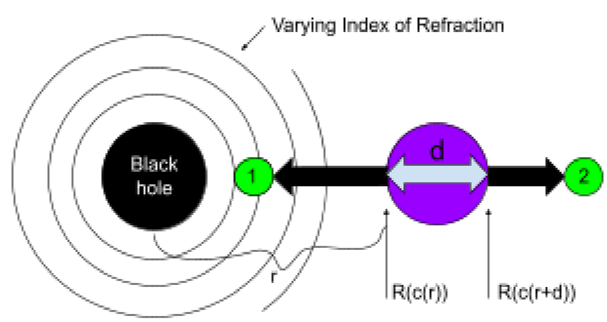


Fig 5 represents an object O (purple) of diameter d, that radiates a uniform field of virtual photons (green) in all directions. All of the photons produce the same momentum on O, uniformly resulting in a net acceleration of zero.

In **Fig 5**, the mathematical framework is illustrated in which an object O, of diameter d, radiates a uniform field of virtual photons in all directions. At this point we are not concerned about conservation laws, as we are just working with concepts. This radiation results in a net force of zero acting on O.

Fig 6 shows object O placed into a non-uniform index of refraction produced by the presence of a black hole. The momentum produced by virtual particle 1 is greater than the momentum of virtual particle 2 producing a type of repulsion.



In **Fig 6**, object O is placed into the non-uniform index of refraction expressed by equation 2. From equation 10, the measured force exerted on O due to virtual photon 1 being emitted is:

$$M(F_1) = \frac{-GMhk}{c\lambda_\infty}\left(\frac{1}{\sqrt{r}(r-\frac{2GM}{c^2})^{1.5}}\right)$$

And the force exerted on O due to virtual photon 2 being emitted is:

$$M(F_2) = \frac{-GMhk}{c\lambda_\infty}\left(\frac{1}{\sqrt{r+d}(r+d-\frac{2GM}{c^2})^{1.5}}\right)$$

The magnitude of the net force is therefore the difference:

$$\left|M(F_{net})\right| = \frac{GMhk}{c\lambda_{\infty}} \left(\frac{1}{\sqrt{r}(r - \frac{2GM}{c^2})^{1.5}} - \frac{1}{\sqrt{r+d}(r+d - \frac{2GM}{c^2})^{1.5}}\right)$$
$$= \frac{GMhk}{c\lambda_{\infty}} \left(\frac{1}{\sqrt{r}(r - \frac{2GM}{c^2})^{1.5}} - \frac{1}{\sqrt{r+d}(r+d - \frac{2GM}{c^2})^{1.5}}\right) \quad (11)$$

Notice that equation 11 is zero for a point particle since $d = 0$). Also notice that this force actually pushes O away from the black hole. This is resolved if the photons are emitted and absorbed internally rather than externally, and this change makes it possible for conservation laws to then be applied. That is, the photons are emitted and absorbed by the same object and thus the total existence of the object remains constant. Since the speed of light is dilated due to interactions with the CE, one could argue that the change in energy of the photons is stored in the CE, and thus it is also conserved.

This model for gravitation does not suggest a new particle, but rather it acts as a concept in which to consider known particles as producing the force of gravity within the nucleus of atoms. For the sake of clarity, equation 11 is not considered complete.

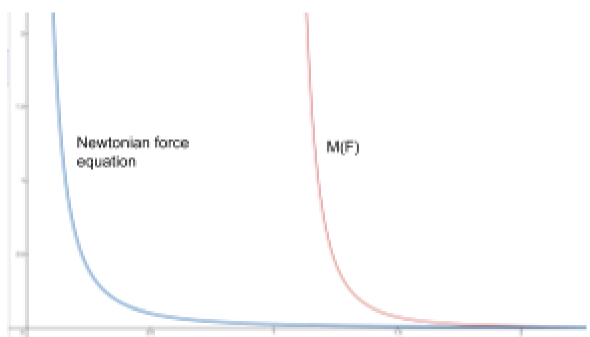


Fig 7 is a graph of the Newtonian gravitational force equation (blue) vs M(F) (red). The two functions have a very similar shape, with M(F) shifted to the right by the distance equal to the Schwartzchild radius ($r_s = 1$ unit as shown in the graph). This shows that up until close to the event horizon, the two functions model a similar force.

In **Fig 7**, $M(F_{net})$ is modeled in red, and the Newtonian gravitational force equation GMm/r^2 is modeled in blue. The two functions are very similar aside from $M(F_{net})$ being shifted to the right by the distance r_s. That is, the two equations produce an almost identical force up until about 2 Schwartzchild radii away from the blackholes center. It is important to note that at some point object O must break apart due to the extreme conditions near the event horizon. Once O breaks apart into small enough particles, d becomes approx. zero resulting in a reduced force, therefore providing a means for the gravitational force to be finite at the event horizon.

7. AUTHORS COMMENTS

Classical logic, mathematics, and physics are the most crucial tools we have for understanding the universe, in that order. Einstein made extraordinary strides in mathematically describing the constitutive equations for essentially everything in the universe. However, his framework ultimately described a structure that could not possibly exist due to its lack of adherence to classical logic. This oversight led to the theory's incompatibility with QM, creating confusion for every theory thereafter that is based on its framework. As discussed above, there is a way for the processes within QM and GTR to work together harmoniously, eliminating paradoxes and demonstrating that there was never a need to deviate from classical logic in the first place.

This theory was initiated and meticulously developed to determine if beliefs in God align with scientific truths and logical principles. It appears that whenever physics seems to contradict God, it is due to a fundamental flaw in the reasoning, as logic necessitates a designer. For example, within this framework, it is impossible for the universe to exist as it does without being influenced by other existences in the set ξ. This issue, known as Olbers' Paradox, is statistically impossible to resolve without the universe being designed with such existences intentionally absent. The properties of the universe modeled by the laws of physics mirror principles used in software development, and the process of evolution resembles a system that creates itself based on a set of predefined rules, similar to self-learning AI.

CONCLUSION

All of the processes of the universe such as time dilation, and superposition, are predictable from a purely logical framework implying that in reality they all adhere to classical logic. Experimentation then determines which of the processes actually occur, and to what extent, and therefore logic coupled with experimentation produces the complete picture regarding The Laws of Existence and the Structure of Our Universe.

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REFERENCES

[1] Deligne, P., Etingof, P., Freed, D. S., Jeffrey, L. C., Kazhdan, D., Morgan, J. W., Morrison, D. R., & Witten, E. (Eds.). (1999). Quantum fields and strings: A course for mathematicians, volume 2. American Mathematical Society.

[2] Higham, N. J. (Ed.). The Princeton Companion to Applied Mathematics. Princeton University Press, 2015, pp. 139-140.

[3] Butkov, E. (1968). Mathematical physics. Addison-Wesley Publishing Company, p. 231.

[4] Copi, I. M., & Cohen, C. (2009). Introduction to Logic (14th ed.). Pearson Education.

[5] Milnor, J. W. (1965). Differential topology. Princeton University Press.

[6] Abbott, B. P., Abbott, R., Abbott, T. D., et al. (2016). Observation of gravitational waves from a binary black hole merger. Physical Review Letters, 116(6), 061102.

[7] Wald, Robert M. General Relativity. University of Chicago Press, 1984, p. 124.

[8] Spacetime and Geometry: An Introduction to General Relativity by Sean Carroll

[9] Rogalski, M. S., & Palmer, S. B. (1999). Quantum physics (p. 25,59,60,44-47). Gordon and Breach Science Publishers.